



Indiana University Scintillator R&D for NOvA

Stuart Mufson

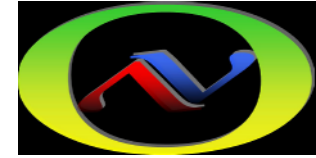
C.Bower, J.Karty, J.Urheim, A.Waldron

Indiana University

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Background

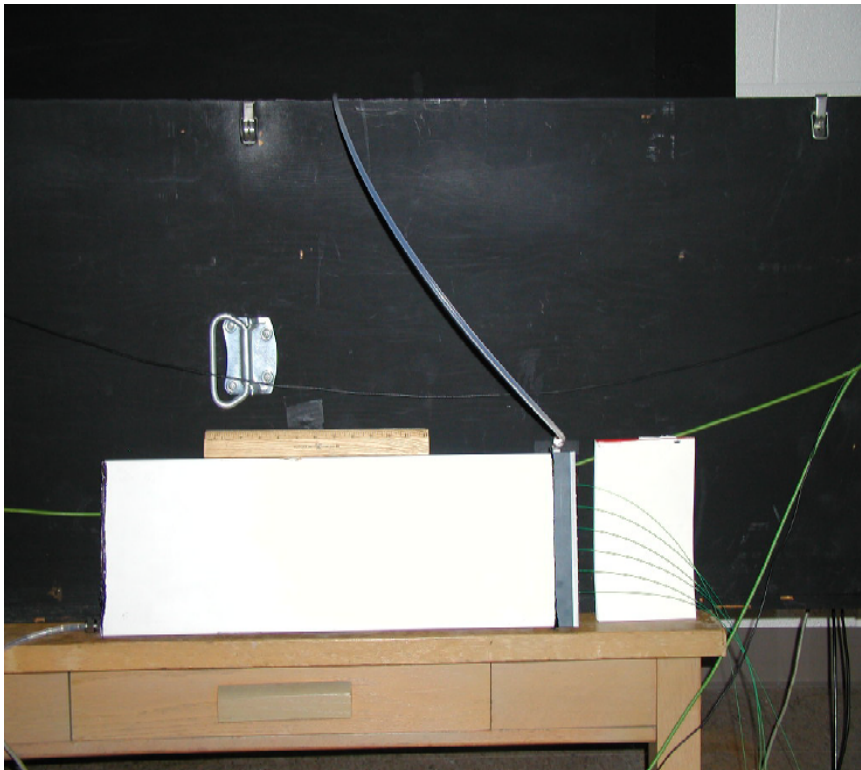
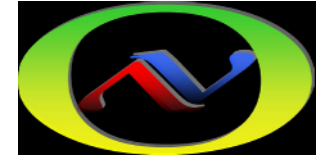


Liquid Scintillator for HEP/Astrophysics

1. **Primary Scintillant** (benzene derivative, e.g. pseudocumene)
 - Atomic/molecular excitations caused by traversing ionizing particle
 - De-excitation produces UV
2. **Waveshifter(s)** (also benzene derivatives, e.g. PPO, POPOP, bis-MSB)
 - Absorb UV, re-emit in visible
3. **“Filler” Solvent** (e.g. mineral oil)
 - Passive component
 - Long attenuation length (relative to other components)
 - To minimize photocathode/volume ratio (save \$)



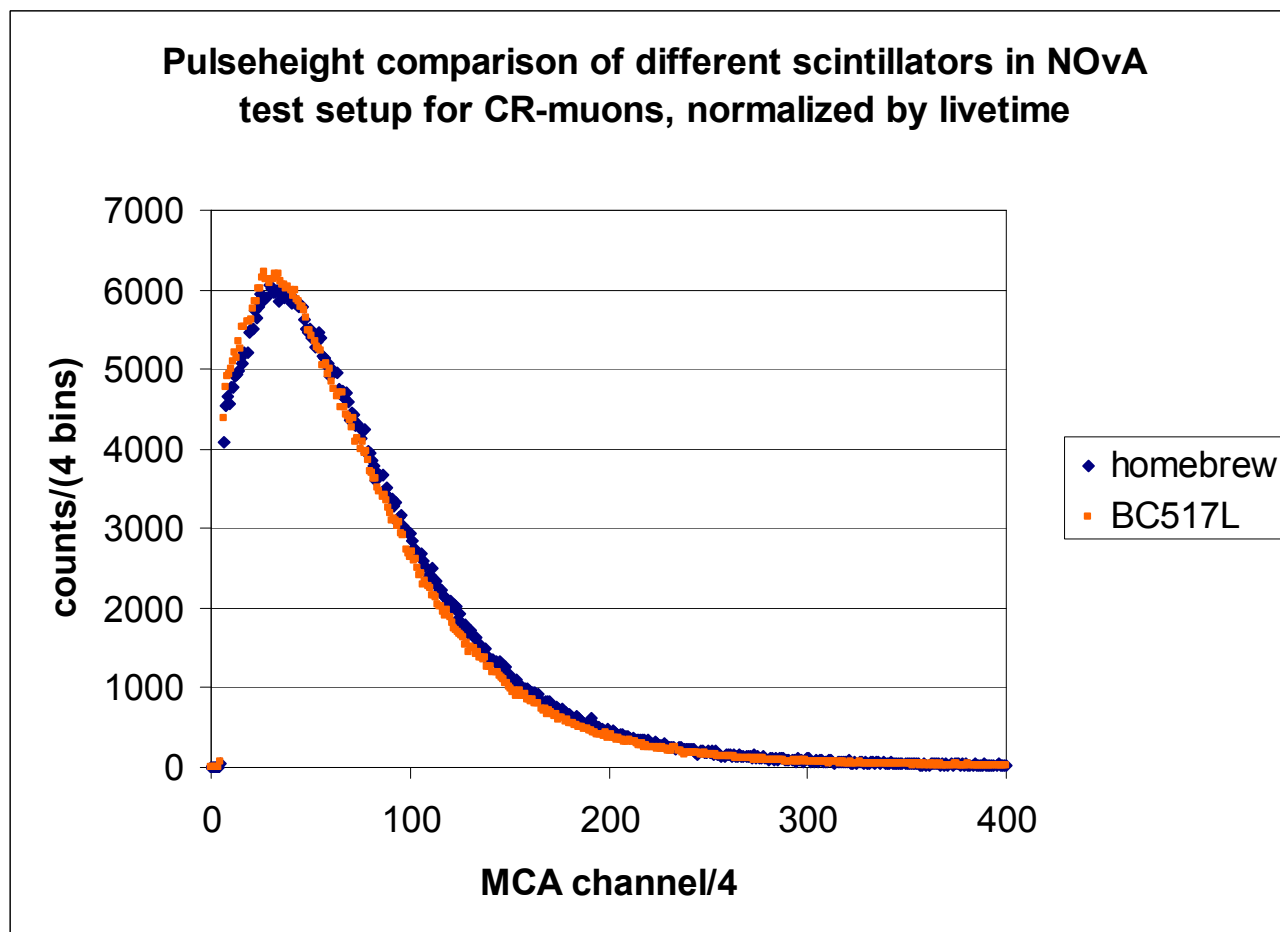
Indiana Test Chamber: $2 \times 5 \times 58 \text{ cm}^3 \times 3 \text{ cells}$



- “MINOS liq. scint. Prototype” extrusions w/alternate walls removed
 - cellsize = $2 \text{ cm} \times 5 \text{ cm}$
 - length = 58 cm
 - reflect. = $94\% @ 425 \text{ nm}$
- Two Bicron WLS fibers per cell, NO loop
 - $0.8 \text{ mm} \times 1.22 \text{ m}$
 - All fiber ends flycut (\approx polished)
- Hamamatsu 4220 PM
 - Nom. QE= $10\% @ 550 \text{ nm}$
 - Optical grease couples fiber to PM
- Trigger on Cosmic Rays (muons, electrons) for the ionizing particles

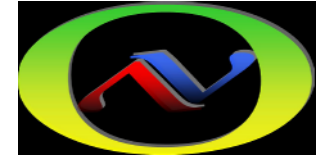


Results: 1/05

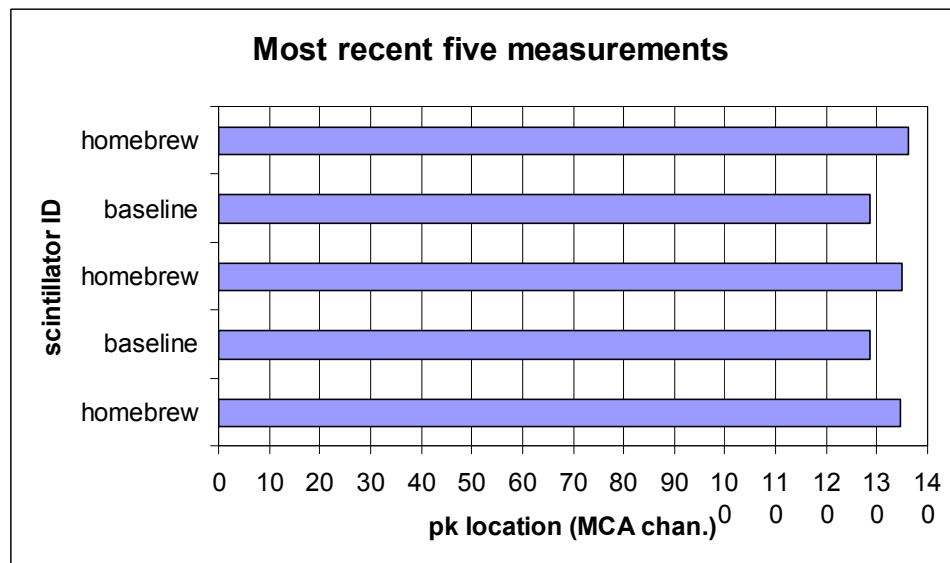




Results: 1/05



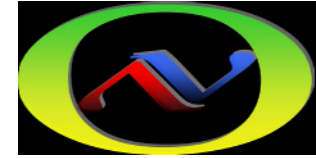
- homebrew consistently gives 5% more light (for significant \$\$ savings)



- flowing N₂ gives an increase of 15% in light output for both BC517L and homebrew



Model: Scintillator Oil Delivery

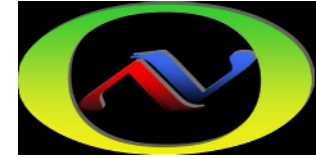


Conceptual Design:

- ❖ mineral oil delivered by tanker truck to scintillator oil mixing facility
- ❖ scintillants delivered by tanker truck to scintillator oil mixing facility
 - scintillant (pseudocumene) delivered from chemical supplier
 - fluor + waveshifters delivered from manufacturer
- ❖ mixing at chemical mixing facility
- ❖ QC at mixing facility before shipping
 - QC by exposing oil to ^{137}Cs and measuring pulse height
- ❖ mixed scintillator oil delivered by heated tanker truck to experimental site in Minnesota



R&D Issues



- From simulations, determine performance requirements to achieve NOvA science goals (#photoelectrons @ far end)

- design mix to meet NOvA's needs
- optimize mix so that cost is minimized

To optimize scintillator mix: multidimensional parameter space search for a big \$\$ item; *best if these requirements were determined early*

- Accelerated fiber aging tests in scintillator
 - likely depends on pseudocumene content in mix; again, best if scintillator composition determined early
 - Allena Oppen at Ohio U asked if she would be interested in this R&D; no reply yet
- Effects of oxygenation on scintillator light yield underway